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ABSTRACT

The Open Learning Institute (OLI) is both an academic institution offering distance education courses and a publishing house for developing and producing distance education course materials. OLI has no resident faculty, but draws science content experts (course writers and consultants) from other academic institutions. The development process begins with determination of the need for a particular science course such as biology, identification of a prospective course writer and consultant, and assignment of a course designer, who coordinates development and production of new courses or revision of existing courses. The designer participates in initial meetings to explain contract terms, the OLI approach, and development procedures; and assists the course writer in constructing a blueprint that delineates the entire course scope and content. Courses are produced in modular booklets called units, with manuscripts submitted individually following formal approval of the first unit by the consultant and OLI. Once course material submission, editing, and design work is completed and approved, the course is submitted for production, which follows a general pattern for science courses, though frequent revisions may be necessary. The OLI is beginning to integrate computer technology into course activities and development procedures. (LMM)

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DEVELOPING BIOLOGY COURSES FOR DISTANT STUDENTS

a paper presented at the

15th Pacific Science Congress,
Dunedin, New Zealand, 1-11 February 1983

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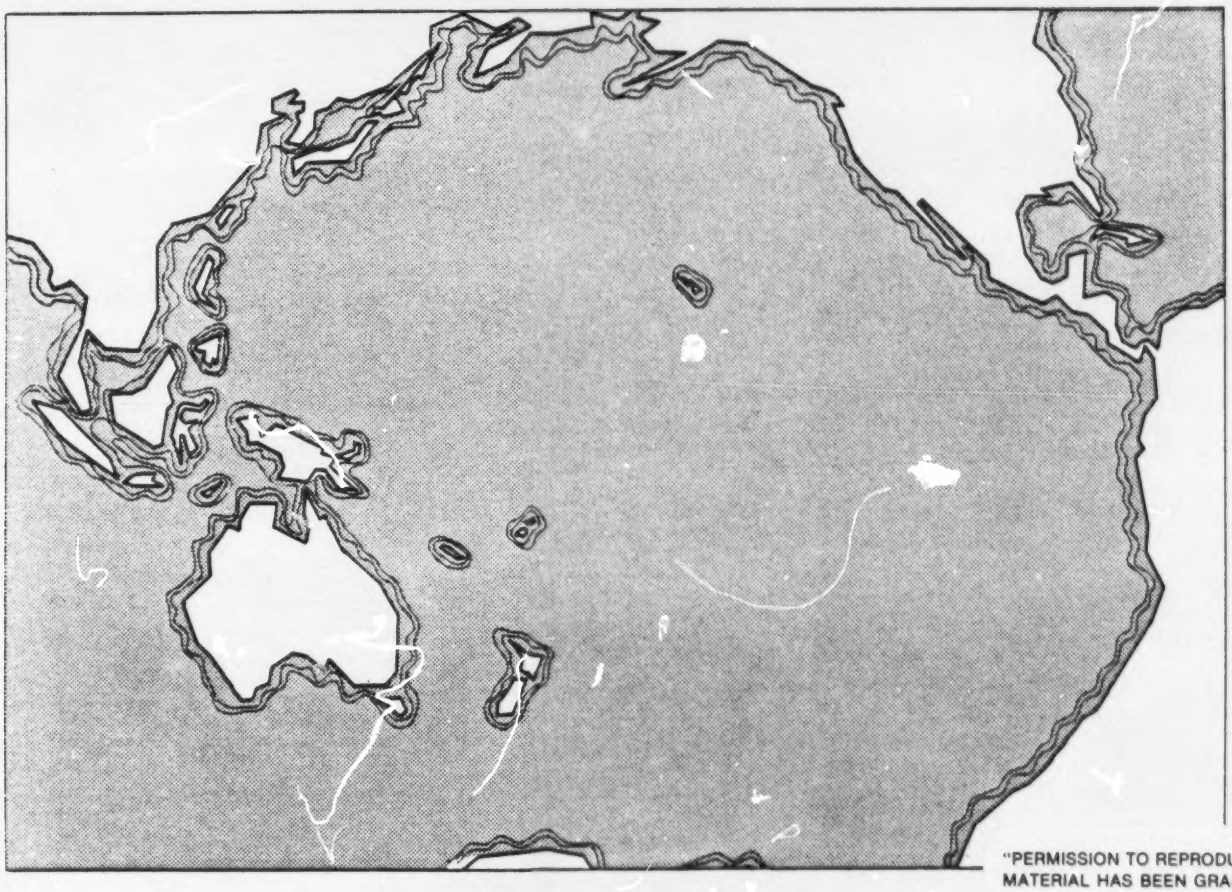

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Introduction

The universal standard for biological science education presumes instruction in experimental methodology and experimental results, in theory, and in laboratory techniques. The standard also prescribes regular revision of instructional material to accommodate scientific advances. However, the development of both distance education biosciences programs, and constituent biology courses, reflects an array of regional factors.

Students entering the Open Learning Institute's (OLI) bioscience program fall into three broad categories. Some do not seek a degree. Instead, they require professional upgrading, or are studying biology for personal interest. Others study introductory and core biology courses at OLI, then transfer to conventional institutions—that is, colleges or universities—to complete their degrees. Still others will pursue all their degree requirements by means of OLI's distance education courses. In each instance, biology students in British Columbia have experienced high quality biology instruction at the secondary school level. They are highly motivated, and, to a considerable extent, are capable of making critical judgments about the quality of their education. This last point is important. In a region where several educational strategies are available, students will not accept poor quality instruction.

Science courses developed for the Open Learning Institute's degree program must meet transfer credit standards imposed by the provincial post-secondary education infrastructure. This requirement carries the additional burden of convincing a sometimes skeptical academic community that acceptable science distance courses can be developed quickly and delivered effectively. Also, recent reductions in funding for education have increased competition amongst institutions, and further brings into question the cost-effectiveness of various education delivery systems. Clearly, distance education faces challenges, whether from students, the academic community, or funding bodies. At OLI we are interested in improving our training methods for distance education functionaries. We are also constantly striving to improve our course development and production methods.

The Open Learning Institute has no resident faculty. Science course writers are mainly drawn from a large pool of academics in the province's universities and regional colleges, and occasionally from universities outside British Columbia. The course writer for our introductory cell biology course worked in Keith Porter's lab at the University of Colorado—the course was developed "at a distance." Content referees, called "consultants" in OLI parlance, are drawn from the same pool. A consultant's primary task is to review manuscripts for their accuracy, and to ensure that they are scientifically up-to-date. A consultant may also assist with the development of a course structure, provide resources such as visual material, suggest supplementary readings, or make editorial comments. However, while our course content experts—that is, course writers and consultants—are highly trained and knowledgeable scientists and educators, very few of them have experience in structures and processes relating to distance education.

Like articles for scientific journals, distance education courses require a special kind of writing. They must be structured to convey aims and objectives, to integrate information from different sources, to anticipate students' questions and problems, and to present opportunities for self-assessment of learning. The structure can encourage students to actively work with content, rather than to passively read and forget.

Experience attests that the greater the assistance offered to course writers in planning and structuring a distance education course, the better is the final product, and the less likely the writer is to find excuses to avoid the task. The more the writer understands of our course development and production methodology, and of our administrative procedures, the greater is the probability of creating a good biology course.

Course development

Once OLI has determined the need for a particular science course, and has identified a prospective course writer and consultant, the course is assigned to a course designer. The course designer acts as a focal point for the development and production of new courses, or the revision of existing courses. He or she is also the instructional designer, editor and, on occasion, audio producer. OLI currently employs eight such designers.

In an initial meeting with a course writer and a consultant, usually held before contracts have been signed, the course designer interprets the terms of the contracts, discusses distance education philosophy and terminology, and explains OLI's copyright requirements. Examinations and testing procedures are also explained, as are the administrative procedures that govern the Institute's interaction with students. As well, instructional design, visual design, and media production processes are clarified. The use of textbooks and supplementary readings are discussed, and OLI's print production sequence is explained. Finally, both writer and consultant are provided with various models and outlines of OLI course material. As you can see, a good deal of information is imparted. Should the contractors decide to undertake the development of the course, the course designer next provides assistance to the course writer in constructing a course blueprint.

Creating a blueprint is the course writer's first task-oriented training in distance education methodology. The blueprint contains a course description, provides schedules for course completion, outlines testing and examination procedures, and identifies course objectives. The blueprint also identifies all course materials, including textbooks and other readings, and provides a course description for insertion in the Institute's annual calendar. The writer is asked to include a schedule for writing and biographical information. Most important, the blueprint contains a comprehensive outline of course contents. That is, headings within each unit of instruction are listed in hierarchical order. Let me briefly diverge here to explain OLI's semester system, and to describe a typical OLI course.

OLI uses a fifteen-week semester system. Thirteen weeks are allowed for instruction, the fourteenth week is given to review, and a final exam is written during the fifteenth week. Our ground rules suggest that the student should complete and submit a first tutor-marked assignment within two weeks of beginning the course. In this way, student-tutor contact is reinforced and the student receives performance feedback. The final tutor-marked assignment should be submitted no later than week thirteen to allow feedback before the final exam.

An OLI course is produced in modular booklets called units. The number of units is variable, but usually reflects natural divisions in the course material. A typical biology course has a course manual, five or six units, and a booklet of tutor-marked assignment

questions. The course may also include an answer key for self-tests, selected readings, a glossary, and a textbook. I will mention this course material a little later, but, for now, let me return to the subject of blueprints.

The detailed course outline is the critically important blueprint item. In it, the course writer delineates the scope and content of the entire course. This allows the consultant and course designer to react immediately to flaws in content or structure. A good course writer, with thorough training, can write a blueprint in less than one week. In fact, both blueprints for our introductory chemistry courses were completed in only four days. However, this exceptional performance is perhaps explained by the fact that the writer was an expatriate New Zealander, even if only from the North Island.

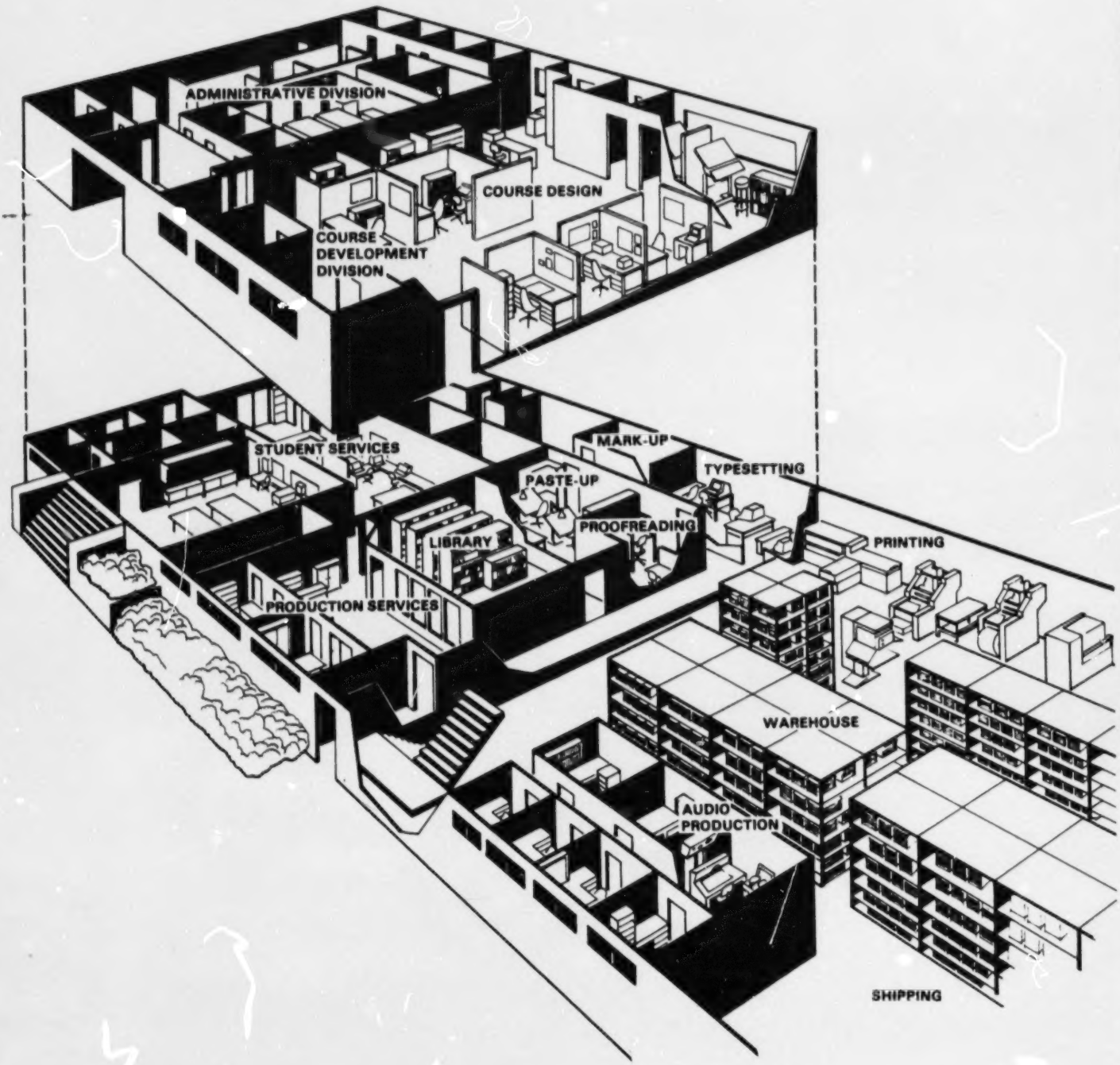
Much of the material in the blueprint is subsequently included in the course manual, a booklet included in the student's course package. Course manuals are also used by OLI student advisors and by the registry to convey basic course information to individuals at other institutions. The course blueprint must be formally approved by the consultant, the course designer, and both the university program area director and the co-ordinator, before the course writer can proceed to write the course material.

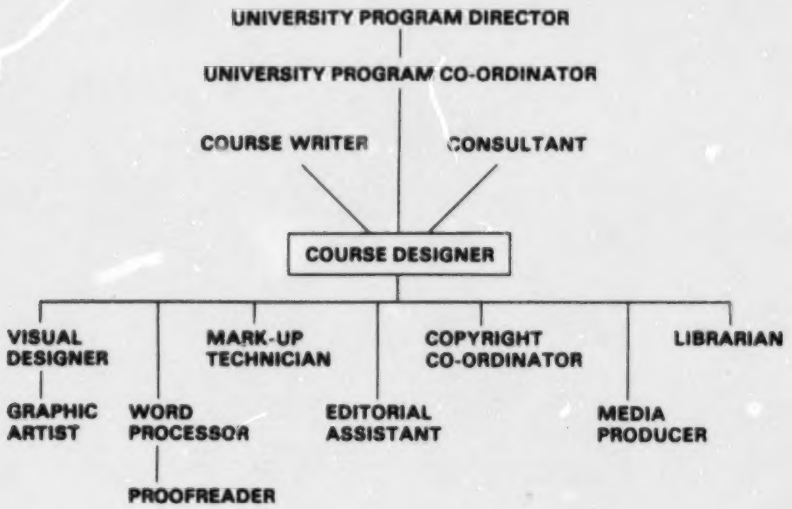
The methods governing the creation of the first unit of instruction are similar to those for the blueprint. By now the number of units, self-testing exercises (called "practice exercises" in OLI jargon), and assignments have been determined and a primary textbook, and supplementary readings have been chosen. A typical unit from a biology course has a contents page, lists of figures and tables, an overview of the unit, a list of readings, learning objectives, a body of text, one or more practice exercises and instructions about the tutor-marked assignment. This first unit acts as a structural model for all other units of the course. Iteration is a well-known natural occurrence. It can be observed in polymer chemistry, DNA replication, or a cellulose molecule. Iterative instructional design tends to make structure transparent. Content is thereby clarified, and the student reassured that his or her expectations will be met.

Another of the course writer's contractual obligations is to write a tutor manual. This manual includes answer keys and marking guidelines for tutor-marked assignments. (In courses without a laboratory component, approximately 60% of the final course mark is generated through assignment completion.) The tutor manual also provides a vehicle for communications from the course writer to the tutor.

With formal approval of the first unit manuscript, again by the consultant and OLI, the writer is paid 10% of the course fee. The course writer then proceeds to write the remainder of the instructional units, assignment file and final exams. You are probably curious as to how much course writers and consultants are paid to write an OLI course. Consultants make $2500 (Cdn.) payable on completion of the course, and writers are usually paid $6000 (Cdn.)—10% after unit one is successfully completed, a further 40% when half the remaining material is submitted, and the final 50% on completion of the contract. For technically complex courses, or in special cases, OLI provides technical typing services, or may adjust the contractors' fees.

LAYOUT OF O.L.I.





Before I describe the course production process, let me offer you a brief tour of the Open Learning Institute. We occupy about 30 000 square feet on two floors of a modern warehouse located in an industrial park south of Vancouver. The administrative division—including personnel services and electronic data processing—and the course development division are located on the upper floor. Student services, including the registry and a student advisory centre, occupies the lower floor, along with production services, the library, and the warehouse.

As you can see, OLI is not only an academic institution, but also a full-fledged publishing house. OLI employs 115 full-time and 12 temporary employees, about 100 tutors spread throughout British Columbia and working in their own homes, and approximately 190 contractors—that is course writers and consultants, editors, researchers, invigilators and exam markers. The Institute is a busy place, with about 100 courses offered, and another 60 under development. Course production is obviously a central preoccupation.

Once a course has been approved for development, the course writer submits manuscripts unit by unit. Manuscripts are word processed and proofread, then a copy is sent to the consultant for review and comments. Next, the course designer redesigns and edits the manuscripts on a word processor terminal. A visual designer, working in conjunction with the course designer, creates thematic illustrations, instructional drawings, and figures and taoles for the course. Permission is obtained for the use of coprighted material, ancillary readings and textbooks are ordered for the warehouse, and, where appropriate, audio tapes are produced. Some of the relationships in effect during course development are shown in the figure below. A university program course designer oversees the development of about ten courses at any given time, and I'll let you extrapolate to the number of interactions involved.

Course production

Once the course writer has submitted all the course material, the editing and design work has been completed, and the consultant's final approval has been granted, the course is submitted for production. A mark-up technician, who has been kept informed of course development progress since blueprint stage, arranges and codes the edited manuscripts for OLI's resident typesetters. Galleys are set on a Wang typesetting system, are proofread and corrected. A paste-up artist then assembles the course, integrating visual and text on print-ready flats. The course is printed in the OLI printshop, collated, bound, and sent to the warehouse for packaging and storage.

The development and production of biology and other OLI science courses follows the general pattern I have described. However, there are invariably special problems with science courses. Both technical typesetting and technical illustrating require special attention to detail, as does editing and proofreading of science material. Whereas a student of a humanities course may be able to interpret a printing error by retreating to the context in which it appears, an error in science or mathematics course material can invalidate a problem set, an explanation, or an illustration. Reprinting electron photomicrographs also requires fastidious attention.

Because some areas of biological science are advancing rapidly, notably genetics and cell biology, science course material must be revised more frequently than material for other courses. Often, the original course writer is unavailable for undertaking these revisions. Therefore, the structure of the course should allow for modular revision. Of course, this process is greatly facilitated through retention of courses on the OLI computer. Biology courses at OLI reflect the excellent textbooks available in North America, and are often thoroughly integrated with them. However, science textbook publishers are issuing new editions with ever-increasing frequency. New editions of textbooks may necessitate major revisions in OLI courses.

Bioscience at OLI

The development of the Open Learning Institute's core biosciences program has required only two years. An introductory biology sequence forms the base for a limited second year program—genetics, cell biology, and ecology. OLI offers two courses for non-biologists. One of these is a television-based marine biology course, purchased from an American producer and adapted for our students' use. We are currently developing our chemistry program, designed primarily to support biology majors. (The italicized print in the figure refers to courses under development or being considered.) Introductory chemistry and organic chemistry offerings, complete with laboratory sections, are standard co-requisites for British Columbia biology students. First year calculus for the biosciences is available and advanced biostatistics is under development.

Firm decisions regarding the expansion of OLI's biosciences program have not been taken. However, you can see that the second year program could be extended to include courses such as developmental biology, physiology, or even zoology and botany. More specialized upper level genetics and cell biology courses, and a biochemistry sequence could be added. In addition, any number of general interest courses could be developed as required. In British Columbia, viticulture, fruit growing, commercial fishing, and forestry are major economic activities. Fisheries biology and plant genetics are potentially useful subjects for distance education courses.

OLI BIOSCIENCE PROGRAM

1ST YEAR	CALCULUS FOR BIOSCIENCES	INTRO. CHEM I INTRO. CHEM II		INTRO. BIOLOGY I INTRO. BIOLOGY II		MARINE BIOLOGY (TELECOURSE) HUMAN BIOLOGY
2ND YEAR		*ORGANIC CHEM I* *ORGANIC CHEM II*	INTRO. GENETICS	INTRO. CELL BIOLOGY	INTRO. ECOLOGY	*DEVELOPMENTAL BIOLOGY* *PHYSIOLOGY* *ZOOLOGY* *BOTANY*
3RD & 4TH YEAR	*BIO STATISTICS*	*BIOCHEM*	*ADV. GENETICS*	*ADV. CELL BIOLOGY*	ADV. ECOLOGY	*APPLIED BIOLOGY*

Distance education and biology are compatible. As we gain experience in developing course materials, new methods for teaching biology students are found. For example, modular computer-assisted instruction packages for use in biology and chemistry labs are being developed, as are audio tapes designed to assist students working with microscopes or chemical models. OLI students enrolled in the biostatistics course will be sent a computer terminal. They will use a statistics software package and the Institute's mainframe computer when undertaking assignments. Their tutor, also on line, will mark assignments electronically and communicate with students by computer mail.

OLI is beginning to provide writers and consultants with computer terminals, printers and modems on trial basis. By doing so, we will decrease re-keying requirements, and provide useful word processing and instructional formats. The integration of such computer technology, sound course development and delivery methods, and traditional science teaching shows good promise for meeting global demands.

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